

Problem Statement

The feasibility of instituting HOV lanes on the Garden State Parkway has been established during a study directed by the New Jersey Department of Transportation, Division of Research and Development with the assistance of the firm of Wilbur Smith and Associates.<sup>1</sup> The end result of this study was a recommendation to establish HOV lanes on the Garden State Parkway.

Construction efforts progress toward an opening date for operation which will coincide with the completion of an added fourth lane in each direction between the New Jersey Turnpike and Route 22, the so-called "state section." As of this writing, the lanes could be available for use as early as mid-December 1979. This date is the anticipated date for completion of the paving of the road. Other aspects of the construction will continue beyond this date until completion sometime in the Summer or Fall of 1980. These are not expected to hamper traffic operations thereby allowing the use of the lanes as soon as lane striping can be accomplished.

Important operational goals have been established as attainable with the HOV lane operating and assembling information from the field will be integral to determining progress toward them. Just as important is establishing that the short term goals, i.e. that the road operates without serious negative effects, are being met.

<sup>1</sup>Garden State Parkway Feasibility Study, Wilbur Smith and Associates, October 1977.





## Operational Goals

The feasibility study recommendation was based in part on the fact that the demand for person miles of travel in 1983 could be satisfied with 10 to 15 percent less vehicle miles. This would also result in a 10 to 15 percent reduction in gasoline usage and could be accomplished without negatively affecting air quality. While these long term goals were identified as attainable, it is also important that the short term effects of the lane are not adverse. Since a lane will be added, there will be improvements to all traffic as compared to pre-construction conditions.

## Objectives

The objective of this evaluation then is to determine whether the lanes are operating within tolerable levels of safety and what progress is being made toward the overall goals of the operation. A recommendation will be made regarding the success of the operation, in terms of pre-determined criteria, from which a determination can be made regarding the viability of continuing the operation beyond six months.

## Background

Extensive review of HOV projects was performed during the feasibility study. The Santa Monica Diamond Lane's 21 week experience occurred during the feasibility study and was monitored closely as were several other HOV lanes which are summarized in Tables I and II. Review of these HOV experiences was instrumental in recommending the reservation of the newly constructed median lanes on the Garden

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TABLE 1

HOV LANE ENFORCEMENT

LOCATION	HOURS OF OPERATION	PEAK HOUR VOLUMES	VIOLATION RATE	LEVEL OF EFFORT	COMMENTS
I-95	6:30-10:00 am SB 3:00-7:00 pm NB	370 Peak Hr. HOV (40 Bus)	75% 3+ occupancy period	No additional patrols because of carpool lane existence	No median shoulders for pull-overs made apprehension difficult
Miami			37% 2+ occupancy period	Seven officers normal	7.5 miles each direction
Banfield	6:30-9:30 am WB 3:30-6:30 pm EB	180 HOV 3845 Non-HOV (33 Bus)	15.5% average 1/76-3/77	Two to three additional officers for peak hours Three days per week Once a month	\$17 fine plus \$10 costs 20% violations used to request saturation patrols
Portland			70 to 80 peak vehicles 1977		3.2 and 1.7 miles
Moanalua Freeway	24 Hours	860 HOV 2760 Non-HOV 6-7 a.m. (5 Bus)	17% in 1974 24 hour 10% in 1975 operation	No additional patrols because of carpool lane existence!	Median shoulders facilitated pullovers - \$25 fine
Honolulu			3% in 1976 peak Lane at capacity in peak period		2.6 and 1.3 miles
Route 101	6:00-9:00 am SB 4:00-7:00 pm NB	400 HOV(95 bus) 5400 Non-HOV 6:45-7:45 a.m.	SB - 5% 87 peak vehicles	5 to 8 California Highway Patrol units	Of 300 violator samples, only two had a previous violation of the HOV lane
San Francisco		315 HOV 5520 Non-HOV 4:30-5:30 p.m.	NB - 20% 153 peak vehicles		Warnings often issued 3.8 miles each direction
Santa Monica	6:30-9:30 am Both Ways 3:00-7:00 am Both Ways	5749 Carpools (170 Bus)	40% Day 1 10 to 20% average	76 Man-hours daily during project Operation hours - After first weeks of 152 man hours daily	Right side pullover despite median shoulders
Los Angeles			80 to 160 peak vehicles		151 warning and citations per day average 12 miles each direction
San Bernardino Express Busway	6:00-10:00 am 3:00-7:00 pm	(4 Hrs.) 1630 HOV (164 Buses) AM, WB 27, 670 Non-HOV 1600 HOV (158 Buses) PM, EB 27, 100 Non-HOV	6 to 12%	360 Hours/Month No Additional Patrols Because of Carpool Lane Existence	Initially 600 Increased to 900 Carpools (4 Hrs.) No noticeable effect on buses 10.5 Miles
Southeast Expressway Boston	6:30-9:30 am	680 HOV before 5900 Non-HOV 1170 HOV when enforced 4900 Non-HOV	Up to 80% non-enforced 35% enforced by mail	4 Patrolling and Observing	Cones 20-40 foot spacing 8 miles
I-280 San Francisco	24 Hours SB Only	5285 Non-HOV 215 HOV peak hr. (15 bus)	10 to 15%	N/A	2 miles
Garden State Parkway (Anticipated)	7:00-9:00 am 3:00-6:00 pm	NR, AM (550 HOV) 8650 Non-HOV SB, PM (785 HOV) 7415 Non-HOV	N/A	4 Troopers, 5 Days a Week for First 2 Months Decreasing to 4 Troopers, 2 Days a Week	12 Miles Each Direction





TABLE 2

## HOV LANE SAFETY EXPERIENCE

LOCATION	DATE OPEN	TRAVEL TIME SAVINGS (Minutes) +	AVERAGE SPEED (MPH)			ACCIDENT RATES (per million vehicle miles)		ACCIDENT TYPES			COMMENTS
			HOV	NON-HOV	DIFF	BEFORE	AFTER	BEFORE	AFTER		
I-95 Miami	7/75 partial 12/75 complete	3.3	am SB 53	38	15 ***	4.48 (486 days)	2.67 (101 days) (2+ occ.)	81% 17% 2%	Rear Side Other	N/C N/C N/C	3&4 mixed + 1 priority lane. No median shoulders. Lane added.
Banfield Fwy. Portland	12/75	1.3 .5	am WB 48	36	12 ***	0.90 (2.5 yrs. prior to constr.)	0.85 (5th mo. after constr.) 0.57 (6/77)			N/A	2&3 mixed + 1 priority lane. No median shoulders. Lane added.
Moanalua Fwy. Honolulu	10/74	3	am 25	17	8 ***	N/A	*1.4 (1975) 2.4 (1976)			N/A	3 mixed + 1 priority lane. Median shoulders.
Route 101 San Francisco	7/76	.6 1.4	am SB 53	47	6 ***	SB 1.55 (6/73-12/73)	SB 2.24 (6/76-12/76)	89% 8% 3%	Rear Side Other	86% 5% 9%	3 mixed + 1 priority lane. Median shoulders. Lane added.**
Santa Monica Fwy. Los Angeles	3/75	2.5-4 EB 5-6.5 WB	N/A	N/A	12	1.40 (3&4/75)	5.10 (21 wks./76) 3.11 (21st week)	68% 13% 19%	Rear Side Other	80% 9% 11%	3&4 mixed + 1 priority lane. Median shoulders.
San Bernadino Express Busway	10/76 partial 6/77 complete	6 <i>up to 18</i> 3.5 <i>up to 8</i>	am WB 55	36	19	1.02 (11/74-10/75)	1.11 (11/76-10/77)			N/A	4&5 + buffer separated priority lane
Southeast Expwy. Boston	5/4/77 to 11/2/77	10 22	am over 11.4 miles without enforcement: 17 24 7			I 3 May PD 4.7 I 2.3 June PD 6.7 I 1.7 Oct PD 2.9 (1970-76)	6 6 3 10 1 8 (1977)			N/A	3 or 4 lanes (including shoulder use during peak) one of which is reserved for 3+ buses. Existing lane removed.
I-280 San Francisco	10/75	1 to 4		N/A		N/A	N/A			N/A	3 mixed + 1 priority lane added. No median shoulder.
Garden State Parkway (anticipated)		1 to 2 1 to 2	am NB 55	48	7	NB 0.88* 1.01 peak per. SB 0.82* 1.20 peak per. (1976)		NB 83% SB 84%	Rear Rear	N/A N/A	3 mixed + 1 priority lane. Median shoulders. Lane added.

\*Rates are 24 hour period.

\*\*The entire priority section was evenly congested throughout in the before condition.

Capacity improvements, in addition to the added lane, precipitated the formation of several unstable pockets of congestion.

\*\*\*Maximum speed differential between HOV and non-HOV lanes is 30 mph.





State Parkway. The review considered three key design factors pertinent to concurrent flow reserved lanes. These are the availability of capacity for non-priority traffic, accessibility to the reserved lane, and the availability of shoulders.

The experiences of other HOV lane operations led to the recommendation that priority operations not be established until an additional lane of capacity is made available. Under such a plan, capacity for non-HOVs on the road is improved since a portion of the traffic currently using the road will be eligible for the HOV lane.

Access and egress of a concurrent flow reserved lane can be either limited, generally to the beginning and end of the lane, or unlimited, meaning HOVs are permitted to enter or leave the lane at any point along its length. While limiting access requires some barrier separating it from the non-priority lanes and thereby implies a degree of safety not available under unlimited access conditions, it reduces the potential users by preventing access via intermediate interchanges. However, the safety improvement may be offset if the median shoulder is not available to non-priority vehicles with an emergency as would be the case with the proposed unlimited access lane.

This last point is important since 10 foot shoulders will generally be available on both sides of each directional roadway. While several sections will exist without a median shoulder, the length involved is less than two of the approximately 12 miles of HOV lane in each





direction. This availability of median shoulder for refuge and enforcement combined with the added lane makes the HOV lane on the Garden State Parkway somewhat unique by comparison.

### Benefits

The benefits anticipated from the Garden State Parkway HOV lane are primarily long term. They are to encourage reduced vehicle miles of travel, reduced gasoline consumption, and improved air quality. This evaluation is intended to establish what progress toward these goals is being made during the first year and the benefit of the evaluation will be to understand how well the operation is performing, to provide this information so that the need for improvements can be identified and provide the data necessary to assist in enforcement and promotional efforts.

### Implementation of Findings

The Division of Research and Development will be responsible for assisting the promotion and enforcement of the HOV lane by collecting pertinent data and reporting the status of the operation on a monthly basis. These reports will be distributed through the Department of Transportation and New Jersey Highway Authority and directly to the State Police, who will be the enforcement agency of responsibility, and the Office of Ridership Development who anticipates managing the promotional efforts through a contractor. A summary report will be issued and a recommendation made based on the performance of the operation during the first six months.





### Work Plan

The reserved lanes will extend from the vicinity of the New Jersey Turnpike, Interchange 129, in the south to the vicinity of Route 22, Interchange 140, in the north - a distance of about 12 miles. The median lanes will be reserved between the hours of 7 and 9 a.m. northbound and 3 to 6 p.m. southbound. Adding northbound hours of 3 to 6 p.m. and southbound hours of 7 to 9 a.m. to the operation will be considered.

### Data Collection

A continuing data collection program will provide input for the evaluation as summarized in Table III.

Since the State Police will be responsible for the reporting of accidents, their files will be used for the accident data source.

Volume and average vehicle occupancy will be counted at two locations on the Garden State Parkway, the New Dover Road and Galloping Hill Road overpasses. These counts will be done once a month for each direction of traffic during the two peak periods for each of the first six months. Data will also be taken during the last month prior to opening. A crew of five men will perform the counts. Two men will obtain the volumes and occupancies of the two HOV lanes during the entire operation of the lanes while the other three men will be collecting the volumes and occupancies of the mixed-flow lanes for twenty minutes per hour per direction from which estimates of hourly





TABLE III

<u>Evaluation Measure</u>	<u>Data Source</u>	
	<u>Continuous</u>	<u>Monthly or As Noted</u>
<u>Safety</u>		
Accident Types	State Police Accident Reports	
Accident Rates	State Police Accident Reports	
Accident Circumstances	State Police Accident Reports	
<u>Weaving</u>	State Police Accident Reports	Field Survey at Int. 138, 136, 135 One Month Prior and 3rd Month of Operation
<u>Enforcement</u>		
Manpower	Police Records	
Violations	Police Records	Field Counts at New Dover Road and Int. 138
<u>Auto Occupancy</u>		
Volume	NJDOT Permanent Count Station NJHA Machine Counts	Field Counts at New Dover Road and Int. 138
Average		Field Counts at New Dover Road and Int. 138
HOVs		Field Counts at New Dover Road and Int. 138
Mode Choice		Field Survey at Union Toll Plaza During 4th Month of Operation
Control Site	NJDOT Permanent Count Station	Field Counts at Rt. 287, Piscataway
<u>Travel Time</u>		
Limits of Congestion and Trip Time by Sub-Section		Field Survey Between New Jersey Turn- pike and Route 22
<u>Air Quality</u>		
LOS		Field Counts at New Dover Road and Int. 138





volumes, peak period occupancy, and violation rates for the HOV lane will be obtained.

Average auto occupancy will also be surveyed on Route 287 in Piscataway Township. A New Jersey Department of Transportation permanent count station is available in this section making it a good location for a control site for comparison of volume and occupancy data. One man will collect occupancy data for each direction once a month during both peak periods at this location.

A crew of two men will measure traffic conditions by traveling the HOV lane section during the reserved hours to provide trip time information by sub-section and identify the extent of congestion. The two men, one driving and one timing, will travel in the mixed flow lanes, passing as many vehicles as pass them, to approximate average travel time. Approximately one travel time per fifteen minutes during the hours of operation per direction will be obtained each month.

In addition to these field counts, two special surveys will be conducted during the first six months. To provide information on weaving conditions, a field crew will record vehicle movements near key interchanges. Galloping Hill Road, Centennial Avenue and Central Avenue, Interchanges 138, 136 and 135, encompass the most regularly congested area of the HOV lane section and are locations where a height advantage exists from which to observe. These interchanges will be observed both during and prior to the HOV operation. Complete weaving maneuvers





across three lanes can require 3,000 feet or more and since overpasses are the best vantage points but are generally located at the beginning or end of the weave, estimates of typical weaving lengths will not be available. For this reason, the volumes of lane changing vehicles in the vicinity of interchanges will be reported. Observations of the travel time crew will be used to assist in reporting observation locations.

During a special survey, HOV drivers will be interviewed for data on how the HOV lane has affected their travel on the Garden State Parkway. The tentative site for this survey is the Union Toll Plaza, a logical choice since all vehicles are stopping to pay the toll. The questions will be designed to allow yes or no answers where possible to minimize delays and simplify evaluation.

Mainline volume data, collected by the Department of Transportation permanent count station within the HOV lane section at New Dover Road, will be available by direction broken down into hourly counts by day of week. Similarly, hourly mainline information at Union Toll Plaza will be available from the New Jersey Highway Authority. Also available will be hourly data the New Jersey Highway Authority collects on a regular basis for ramps throughout the HOV section. This data will be supplemented by New Jersey Department of Transportation counts.

#### Evaluation

The most important aspect of the HOV lane will be the safety experience for the facility. Accident rates,





types, and lane of occurrence will be determined for both HOV and non-HOV hours.

An initial increase in accident experience can be expected as a result of new or unusual traffic management systems such as HOV lanes. Accident rates in Table II for the before condition on concurrent flow HOV facilities range from below one per m.v.m. to as high as four per m.v.m. Over the first year of operation, the accident rates generally drop back.

Typically the lane adjacent to the HOV lane experiences a disproportionate amount of the accidents on the road. This has been attributed to the speed differential which exists. This speed differential is the source of the travel time savings so it would appear that the more successful the lane is in this sense, the more negative the accident experience is likely to be. However, adding capacity in order to accommodate an HOV lane will minimize impacts on speed differentials by maintaining the level of service in the existing lanes.

Therefore, the accident experience on the Garden State Parkway will be weighed against progress toward the other operational goals set. Recommendations will be made to correct any lane marking or geometric related hazards which can be identified.

Other factors which will be evaluated include violation rates and enforcement levels, auto occupancy rates, travel time differentials, and air quality impacts. These





measures are expected to further reflect the ability of the lane to be managed, indicating progress toward long term benefits which will only be achieved by maintaining the advantages offered by the lane.

The advantage of uncongested travel will be maintained through enforcement of the minimum occupancy rules. The enforcement activities necessary to maintain the operation of the lane will be compared to anticipated enforcement rates of five days per week over the first two months, three days per week for the third, fourth and fifth months, and two days per week in the sixth month. Also reported will be the violations of the minimum occupancy rule. Based on experience elsewhere, the level of violations should be maintainable at about 20 percent or less of HOV lane traffic with this type of gradually reduced enforcement effort. Two days a week on a random basis is the minimum expected.

Another reflection of the effectiveness of the HOV operation is increases in auto occupancy. The preconstruction average occupancies ranged from about 1.3 to about 1.5 people per vehicle, with the southbound evening being the higher of the two. These rates are the result of the fact that from 2/3 to 3/4 of the vehicles on the road were occupied by only the driver. At these rates, only five to ten percent of the vehicles are occupied by three or more persons, the level necessary for HOV eligibility. Increasing the number of carpools on a continuing basis is currently considered to be a goal. Progress toward this goal will be evaluated on the basis of the monthly occupancy counts. The results of





the HOV interview survey of changes in trip characteristics will be included in this part of the evaluation. Also included will be an indication of changes which occur independently of the HOV lane as reflected by the control site information.

Conditions in the HOV lane itself must be maintained at free flow during congestion for HOVs to have an advantage. The travel time differential from this advantage will be evaluated by section of road since the level of congestion in the mixed flow lanes is expected to vary considerably. The actual travel time advantage for each HOV will be dependent on trip origin and destination. This is because access to the lane is not limited to specific entry and exit points.

Adding the fourth lane in the so-called free section as an HOV lane is expected to minimize changes to the air quality since it will tend to minimize changes in volumes from previously recorded three lane conditions. With previously documented demands, congestion in the three mixed flow lanes will remain unchanged or diminish since the HOV lane would be available to ten percent or less of the existing traffic. However, demands are expected to increase over time and for this reason, volumes and levels of service information will be reviewed for impacts.



	1979					1980						1981			
	NOV	JAN	MAR	MAY	JULY	SEP	NOV	JAN	MAR	MAY	JUL				
	X	X	X	X	X	X	X	X	X	X	X				
Pre-opening Data Collection	—														
Monthly Data Collection		—	—	—	—	—									
Weaving Study	—		—												
Driver Interviews			—												
Evaluation	<hr/>														
Reports															
Status		X	X	X	X	X									
Interim					X					X					
Final												X			





MANPOWER ESTIMATE

<u>TITLE</u>	<u>FY 80</u>	(Man Months) <u>FY 81</u>	<u>TOTAL</u>
Principal Engineer	3	5	8
Senior Engineer	5	8	13
Engineering Aides	5	8	13
Clerical	.5	1	1.5

BUDGET ESTIMATE

	<u>FY 80</u>	<u>FY 81</u>	<u>TOTAL</u>
Salaries	18,360	14,670	
Overhead	5,925	2,934	
Expendable Materials	200	100	
Printing	160	75	
Travel	40	0	
Data Processing	400	100	
Vehicle Usage	1,600	500	
	26,685	18,379	45,064





GARDEN STATE PARKWAY HOV LANE  
SUPPORT ACTIVITIES

<u>Activity</u>	<u>Status</u>	<u>Current Implementer</u>	<u>Potential</u>
Easy Access for Press	Underway	Debbie Lawler John Powers	Good
Cooperate with Citizen Interest Groups	Planned	Public Affairs Community Involvement	Good
Local Government Acceptance	Planned	Speakers Bureau	?
Advertising/Marketing	Underway	John Powers	Good
Handouts to Motorists	Planned but NJHA is opposing	John Powers NJHA	?
Employer-Based Matching and Ridesharing Information	Underway but only thru employers	Ridesharing Public Affairs	Good
Reserved Toll Booths or Bypass Lanes	Opposition at Authorities	NJHA NJTA	?
Reduced Tolls	Opposition at Authorities	NJHA NJTA	?
Park-Ride/Park-Pool Facilities (Joint or Separate)		ROW Design Traffic Construction-Maintenance	Good
Cooperate with Traffic Advisory Radio		John Powers	Good
Enforcement-High Visibility	Will begin with HOV operation	John Powers	Good
Cooperate with State Police	Underway	John Powers	Good
Free or Preferential Parking at Destination	Underway for employers in Ridesharing Program	Ridesharing	Good
Increase Surveillance for Incident Detection	Planned for MAGIC	Local Aid	Good



<u>Activity</u>	<u>Status</u>	<u>Current Implementer</u>	<u>Potential</u>
Implementation of Other HOV Lanes	Planned and existing	Design	Good
Express Bus Service with Park-n-Ride	Reviewed once- No interest	NJ TRANSIT	Medium
Individual-Based Matching Service		Ridesharing Public Affairs	Low
Bus Signal Preemption on Arterials		Traffic Electrical Local Gov't.	Low
Ramp Metering	Not planned	ROW-Design Traffic- Construction/ Maintenance	Low
Exclusive Ramps	Not planned	Traffic Maintenance	Low
Auto Restricted Zones	Not planned	Local Gov't.	Low
Turning Priorities on Arterials	Not planned	Traffic Maintenance Local Gov't.	Low





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